REVISION OF SOME SERPULIDAE (ANNELIDA POLYCHAETA) FROM ABYSSAL DEPTHS IN THE ATLANTIC AND PACIFIC, COLLECTED BY THE "CHALLENGER" AND PRINCE OF MONACO EXPEDITIONS

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CONTENTS

	Page
Introduction	427
Systematic descriptions and notes	428
Bathyvermilia gen. nov.	428
Bathyvermilia challengeri sp. nov.	428
Bathyvermilia langerhansi (Fauvel, 1909) comb. nov.	431
Indeterminable Serpulidae from abyssal depths previously referred to *Placostegus*	435
Placostegus benthalianus McIntosh, 1885	435
Placostegus moerchii McIntosh, 1885	436
Summary	437
Acknowledgements	437
References	437

INTRODUCTION

In connection with a study of little-known species of abyssal serpulids collected by some early deep-sea expeditions, it was found that two species, described under *Placostegus ornatus* by McIntosh (1885) and collected by the "Challenger" expedition in the abyssal depths of the North and South Pacific, and *Vermiliopsis langerhansi* by Fauvel (1909), collected by the Prince of Monaco expeditions in the deep parts of the North Atlantic, show some common characters which set them apart from *Vermiliopsis, sensu stricto,* as well as from *Placostegus.* Both species are herein redescribed in detail and referred to *Bathyvermilia* gen. nov. The present review is the second in a series of revisionary studies on the former genus *Vermiliopsis, sensu lato.* The first one dealt with the genus *Metavermilia* Bush (Zibrowius, 1971).

Additional comments are made on two incompletely known serpulids of doubtful generic status, *Placostegus benthalianus* and *Placostegus moerchii,* both collected by the "Challenger" from abyssal depths in the North and South Pacific and described by McIntosh (1885) from rather incomplete and damaged specimens.

This study is based on material in the collections of the British Museum (Natural History), London (BMNH), Marine Biological Association U.K., Plymouth (MBAP), Naturhistoriska Museet, Göteborg (NHMG), Muséum National d'Histoire Naturelle, Paris (MNHN), Musée Océanographique de Monaco (MOM).

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SYSTEMATIC DESCRIPTIONS AND NOTES

BATHYVERMILIA gen. nov.

Type-species: *Bathyvermilia challengeri* sp. nov. [=*Placostegus ornatus*: McIntosh, 1885]. Gender: feminine.

Diagnosis. Tube white, opaque (not vitreous), with more or less distinct sculpturing, subtriangular or subquadrangular in cross-section. 7 thoracic segments, 6 of them uncinigerous. First thoracic segment with setae similar to those of the following segments (no special setae); thoracic sickle setae ("*Apomatus* setae") present, abdominal setae geniculate. Thoracic uncini saw-shaped, with few teeth (about 6 to 10), anterior tooth simple (not bifurcate); abdominal uncini saw-shaped, similar to thoracic uncini, except in a few far posterior segments with rasp-shaped uncini. Thoracic membranes short, ending at about the second or third segment. Gill tuft without gill membranes uniting bases of filaments and without pseudo-operculum; basal lobes rather elongate. Second dorsal filament transformed into a cylindrical smooth opercular stalk, without pinnules or wings. Operculum with simple, entire horny cap encrusted by calcareous deposit.

The following species are herein referred to *Bathyvermilia*: *B. challengeri* sp. nov. [=*Placostegus ornatus*: McIntosh, 1885], Central North and South Pacific, abyssal depths.

B. langerhansi (Fauvel, 1909) [=*Vermiliopsis langerhansi* Fauvel, 1909], Central North Atlantic, abyssal depths.

Notes. While in *Vermiliopsis, sensu stricto*, the opercular stalk is formed by the first dorsal filament on one side, it is formed by the second dorsal filament in *Pseudovermilia* Bush (emend. Zibrowius, 1970), *Metavermilia* Bush (emend. Zibrowius, 1971) and *Bathyvermilia.* Tubes flaring out in successive wide peristomes are typical of all known true species of *Vermiliopsis, sensu stricto*, but are not found in the other genera. *Bathyvermilia* is distinguished from *Metavermilia* chiefly by its cylindrical (not ribbon-like) opercular stalk, and from *Pseudovermilia* by its uncini (anterior tooth simple, not bifurcate).

The accompanying table summarises the principal differences of the four genera previously united by various authors under *Vermiliopsis*.

Bathyvermilia challengeri sp. nov.
(Fig. 1a–d)

Placostegus ornatus: McIntosh, 1885, pp. 522–524, pl. 55, fig. 5–6, pl. 30A, fig. 25–27. Not *Placostegus ornatus* (Sowerby MS) Mörch, 1863.

Material studied. Mid-Pacific, "Challenger" expedition, station 244, 28 June 1875, 35°22′ N, 169°53′ E, 5307 m, bottom temperature 1·83°C, red clay (Paratype: fragment of one specimen without gill tuft or operculum, tube fragment, BMNH. 1885.12.1.411). Station 253, 14 July 1875, 38°09′ N, 156°25′ W, 5719 m, bottom temperature 1·72°C (Paratype: tube fragment, BMNH. 1885.12.1.412). Station 285, 14 October 1875, 32°36′ S, 137°43′ W, 4346 m, bottom temperature 1·66°C

	Vermiliopsis Saint Joseph [emend. Zibrowius, 1970]	*Bathyvermilia* gen. nov.	*Metavermilia* Bush [emend. Zibrowius, 1971]	*Pseudovermilia* Bush [emend. Zibrowius, 1970]
type-species	*V. multivaricosa* Mörch, 1863 [= *V. infundibulum*: (Philippi, 1844)]	*B. challengeri* sp. nov.	*M. multicristata* (Philippi, 1844)	*P. occidentalis* (McIntosh, 1885)
anterior tooth of uncini	simple	simple	simple	bifurcate
Opercular stalk				
a. position	1st filament	2nd filament	2nd filament	2nd filament
b. shape	cylindrical	cylindrical	ribbon-like, flat	cylindrical
tube	subcircular or subquadrangular in cross-section, flaring out in successive wide peristomes, often with several smooth longitudinal keels	subtriangular or subquadrangular in cross-section, without peristomes, sometimes with transverse sculpturing	not flaring out in successive wide peristomes, otherwise variable, generally with longitudinal keels	subtriangular in cross-section, often with transverse sculpturing

(Holotype: fragment of one specimen with gill tuft, operculum and tube fragment; Paratype: fragment without gill tuft, BMNH. 1885.12.1.413).

Description. Diameter of tube up to 2 mm. Tube white, thick and hard, with bright surface, subquadrangular in cross-section, with slightly dilated basal attachment; numerous, close, well marked, crest like, smooth transverse ridges encircling tube; transverse ridges directed slightly forward in midline; no longitudinal keels; longitudinal groove cutting transverse ridges into isolated lower bars near base and continuous upper bars.

Length of specimens up to 19 mm, length of gill tuft up to 7 mm. 7 thoracic setigerous segments, 6 of them uncinigerous. Number of abdominal segments unknown. Details of collar structure unknown. Thoracic membranes very short, ending at about second setigerous segment.

Gill tuft of about 12 filaments on each side; basal lobes long and slender; no gill membranes. Second filament on left side transformed into smooth opercular stalk, without pinnules or wings, slightly enlarged at base of operculum.

Operculum subglobular, somewhat higher than wide, with slightly convex simple distal plate; opercular plate smooth, thin, with white calcareous deposit and two indistinct concentric zones.

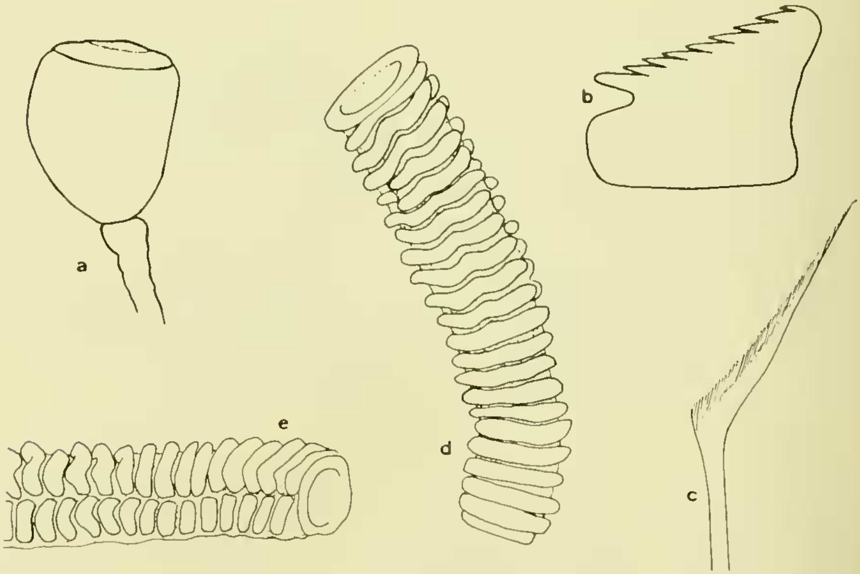

Fig. 1. *Bathyvermilia challengeri*. a: operculum; b: thoracic uncinus; c: abdominal seta; d, e: tube, upper side and side view.

First thoracic setigerous segment with two types of setae: uniformly simple limbate and thin capillary. Similar setae in segments 2 to 7. Additional thoracic setae with short proximal limbate zone ("*Apomatus* setae") present in segments 3 to 7. Abdominal setae geniculate, with rather broad triangular blade. Thoracic uncini saw-shaped with about 7 to 10 teeth; anterior tooth simple (not bifurcate). Anterior abdominal uncini similar to thoracic uncini; uncini of far posterior segments rasp-shaped.

NOTES. McIntosh (1885) erroneously referred his specimens from the "Challenger" stations to *Placostegus ornatus* (Sowerby MS) Mörch, 1863, a littoral serpulid from the Philippine Islands and described from the tube only. The sculpturing of the tube of McIntosh's deep-water species is characteristic and the tube fragments from the three "Challenger" stations in the North and South Pacific (halfway between Hawaii and Japan, Hawaii and Alaska, and South of Touamotou archipelago) are similar.

As Mörch had studied various shell collections in search of serpulids, he had probably seen Sowerby's original material of *Serpula ornata* (manuscript name or unpublished name found on a museum specimen ?). He then described (Mörch, 1863, p. 420) two "varieties" of *Placostegus ornatus*, both observed in Cuming's collection on shells from the Philippine Islands (rather detailed but not illustrated descriptions of the tubes only): var. *articulata* (on *Arca obliquata* Reeve) and var. *pennata* (on *Ostrea hyotis*). The types of Mörch's var. *articulata* have been rediscovered recently (BMNH. 1965.31.14–16). These tubes are similar to other serpulids such as *Spirobranchus*, *Pomatoceros*, *Pomatoleios*, and *Galeolaria*. A preserved operculum was extracted from one of these tubes; it is a massive calcareous operculum similar to that of *Pomatoleios kraussii* (Baird).

Bathyvermilia langerhansi (Fauvel, 1909) comb. nov.

(Fig. 2a–k)

Vermiliopsis langerhansi Fauvel, 1909, pp. 61–62, fig. 6a–d.
[part.] *Vermiliopsis langerhansi*: Fauvel, 1914, pp. 334–346, pl. 29, fig. 22–32. Fauvel 1927, pp. 363–365, fig. 124h–g.
Vermiliopsis sp.: Eliason, 1951, p. 142, pl. 1, fig. 7–8.
[?] *Vermiliopsis ? langerhansi*: Hartman & Fauchald, 1971, p. 181.
NOT *Vermiliopsis langerhansi*: Bellan, 1960, p. 289, 1963, p. 264 [= *Vermiliopsis agglutinata* (Marenzeller)].
NOT *Vermiliopsis langerhansi*: Southward, 1963, p. 584 [= *Vermiliopsis eliasoni* Zibrowius].
NOT *Vermiliopsis langerhansi*: Bellan, 1964, p. 175.—Cabioch, L'Hardy & Rullier, 1968, p. 73.—Chapman & Dales, 1954, p. 682.—Nelson-Smith, 1967, p. 33, fig. 20.—Tenerelli, 1961, 1962 [all: *Vermiliopsis* sp.].

MATERIAL STUDIED. North Atlantic, Prince of Monaco expeditions, station 527, 25 June 1895, east of Azores, 38°08′ N, 23°18′45″ W to 38°09′ N, 23°15′45″ W, 4020 m (4 SYNTYPES: specimens or fragments, 3 of them without abdominal region, tube fragments, MOM.—2 SYNTYPES: anterior fragments without abdominal region, tube fragments, MNHN).

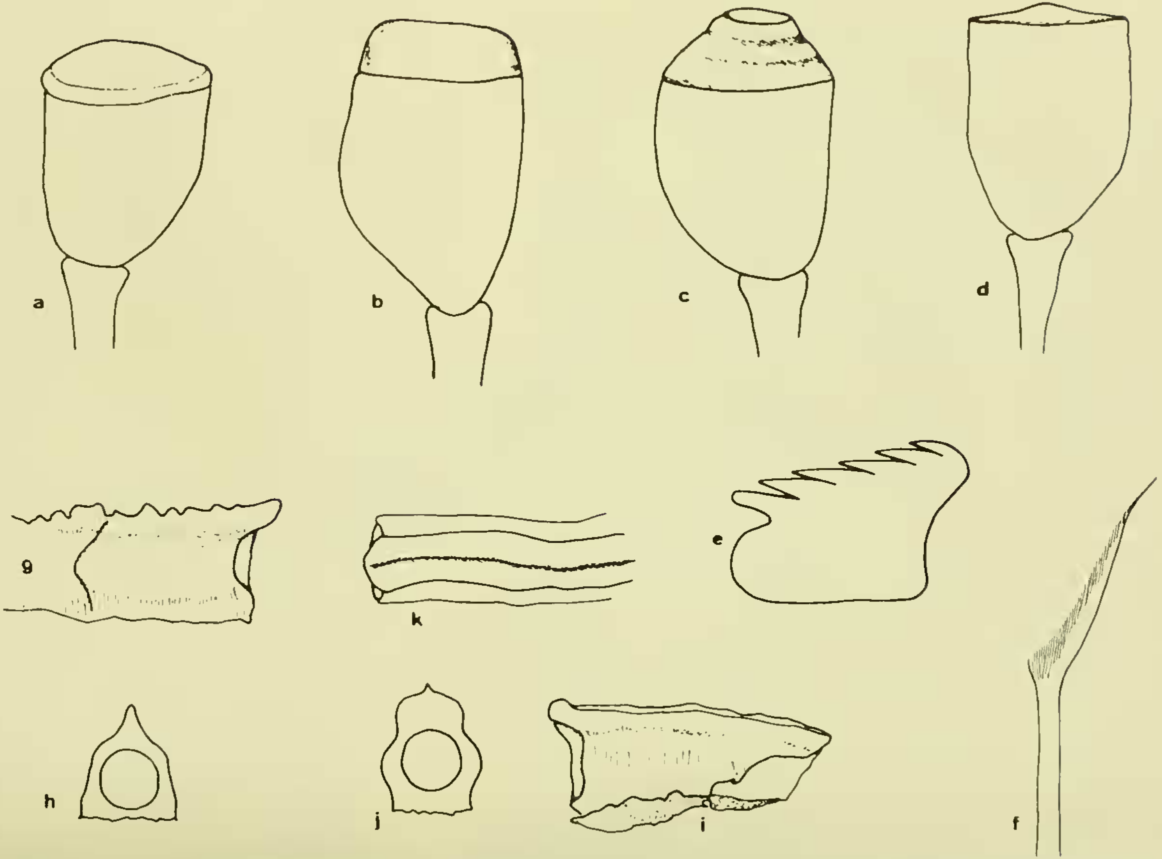

FIG. 2. *Bathyvermilia langerhansi.* (a–h: from type locality, d labelled "Nacqueville 8.7.1911"; i–k: from Swedish Deep Sea Exped. station 373) a–d: opercula; e: thoracic uncinus; f: abdominal seta; g, h: tube, side view and cross section; i, j, k: tube, side view, upper side, and cross section

North Atlantic, Swedish Deep Sea Expedition, station 373, 23–24 August 1948, south-east of Bermuda, 28°25′ N, 61°05′ W to 28°05′ N, 60°49′ W, 5500–5987 m (1 specimen: anterior fragment, tube fragment, NMG. 11015).

DESCRIPTION. Diameter of tube about 2 mm. Tube white, smooth, thick and hard, with bright surface, subtriangular in cross-section, as high as wide, not encrusting substratum. Tubes of syntypes with median keel irregularly denticulate and forming prominent tooth over orifice; no well-marked lateral keels or ridges; some transverse ridges across the tube. Tube of specimen collected by the Swedish Deep-Sea Expedition with upper face rather flat and wide, with median keel.

Larger specimens all incomplete: anterior region including gill tuft and thoracic segments, about 10 mm long; operculum up to 1·2 mm in diameter. The single complete, smaller specimen with about 50 abdominal segments. 7 thoracic setigerous segments, 6 of them uncinigerous. Thoracic membranes rather short, extending to about segment 3. Gill tuft composed of about 15 filaments on each side, forming single row on slightly elongate basal lobes; without gill membrane or pseudo-operculum. Second dorsal filament on either side transformed into smooth stalk, cylindrical, slightly enlarged at base of operculum.

Operculum vesicular, slightly elongate, higher than wide, with distal brown horny cap encrusted by calcareous white deposit (calcareous deposit sometimes lost). Opercular plate generally flat or slightly convex, but sometimes forming short cylinder or section of cone (simple, not subdivided into transverse layers).

First thoracic setigerous segment with two kinds of setae: stouter limbate with narrow uniform wing and smaller capillary; similar setae in following thoracic segments but more numerous. Additional sickle setae with short proximal limbate zone ("*Apomatus* setae") present in some posterior thoracic segments. Abdominal setae geniculate, with denticulate wing; posterior segments with long capillary setae.

Thoracic uncini saw-shaped, with 6 teeth; anterior tooth simple, not bifurcate. Uncini of anterior abdominal segments similar to those of thoracic region (saw-shaped, 6 or 7 teeth); uncini of posterior abdominal segments rasp-shaped and with more teeth when seen in profile.

NOTES. In former publications (Zibrowius, 1968a : 124–125; 1968b : 8, footnote), it was pointed out that there was some confusion regarding *Vermiliopsis langerhansi* Fauvel, especially as Fauvel himself confused the abyssal species with a shallow water form.

The original description of *Vermiliopsis langerhansi* by Fauvel (1909) was based on specimens from abyssal depths east of the Azores. All specimens examined by Fauvel consisted only of anterior fragments (a supplementary complete specimen was extracted from its tube when the original material was recently studied again).

Fauvel (1909) questionably included in the synonymy of his abyssal new species the record of *Vermilia clavigera* by Langerhans (1884) from shallow water around Madeira. Based on a study of Langerhans' specimens, Marenzeller (1892) referred this record to a quite different species, *Vermilia multicristata* Philippi, 1844, better known under the name *Vermiliopsis multicristata* and recently transferred to the genus *Metavermilia* Bush (Zibrowius, 1971). Taking for granted the identity of his fragmentary abyssal specimens with those described by Langerhans (1884) from Madeira, Fauvel apparently combined his own observations with those by Langerhans on the other species. He further misunderstood Marenzeller's remarks, and believing that Langerhans' *Vermilia clavigera* should not be referred to *Vermiliopsis multicristata* (Philippi) and that the name *clavigera* was preoccupied (by Philippi, 1844), he named the abyssal new species *Vermiliopsis langerhansi*.

In the original description of the abyssal species by Fauvel (1909), the calcareous deposit found on some opercula (lost on other opercula) was not mentioned. The tube was not correctly described; it is not encrusting and wide but subtriangular in cross-section and lacking well-marked smooth lateral keels; thus it does not resemble the tube of *Vermiliopsis agglutinata* (Marenzeller) as erroneously stated by Fauvel.

Later Fauvel (1914) redescribed the same specimens from east of the Azores without any further details. He only added the remark that in 1911 he had found the same species in the English Channel (near Cherbourg); the description (otherwise the same as in 1909) was now more abundantly illustrated, including a figure of the geniculate abdominal setae (apparently from specimens other than the truncate ones from abyssal depths).

Finally, Fauvel (1927) included *Vermiliopsis langerhansi* in the "Faune de France" because of its supposed occurrence in the English Channel (intertidal zone). The description was now modified by the remark that the distal horny plate (rather flat or hemispherical) was encrusted by a calcareous deposit. As this detail had not been mentioned in the earlier descriptions (though it can be now confirmed after the syntypes were re-examined), the calcareous deposit was probably observed by Fauvel on the intertidal specimens from the English Channel.

Undoubtedly Fauvel's littoral form is a form close to *Vermiliopsis infundibulum* (Philippi, 1844) characterized by a short horny operculum encrusted by a calcareous deposit. Analogous forms are quite widespread along the Mediterranean and Atlantic coasts. The passing remark by Fauvel (1919) that *Vermiliopsis langerhansi*, as well as *Vermiliopsis glandigera* Gravier, may be nothing but a juvenile form or a "variety" of *Vermiliopsis infundibulum* (Philippi), was probably made in regard to the littoral form, rather than to the abyssal species.

In the collection of the Muséum National d'Histoire Naturelle (Paris), an anterior fragment was found labelled "*Vermiliopsis langerhansi* F., Nacqueville, 8.7.1911" (in Fauvel's own handwriting). By all observable details (operculum, position of opercular stalk, uncini) this specimen is identical to the syntypes from the type locality in the Central Atlantic (Prince of Monaco expeditions, station 527) and does not belong to a form close to *Vermiliopsis infundibulum* (Philippi). In spite of its label, the specimen in question does not appear to be Fauvel's littoral form but a specimen from the type locality of the abyssal species. It would appear that labels had been mixed up (similar label errors concerning other species have been detected in Fauvel's collection).

Since Fauvel (1914, 1927) had apparently confused a shallow water species with an abyssal species under the name *Vermiliopsis langerhansi*, other authors subsequently reported serpulids under that name from shallow water as well as from great depths (however, the records from bathyal and abyssal depths were less numerous than those from shallow water). Only one or two of all these records are referable to the abyssal species *Bathyvermilia langerhansi*, as revised herein.

Eliason (1951) described a small serpulid as *Vermiliopsis* sp. ("perhaps *V. langerhansi*") collected off Bermuda (depth about 5500 m). This specimen was re-examined (NMG. 11075) and it proved to be the same species.

Some deep water serpulids from the continental slope south of Martha's Vineyard (39°43,6′ N, 70°37,4′ W, 2022 m) and briefly characterized by Hartman and Fauchald (1971 : 181—operculum consisting of a simple, cylindrical stalk topped by a translucent ampule with a flat top, circular in full view and calcareous) possibly belonged to the same species.

Southward (1963 : 584, species list) reported *Vermiliopsis langerhansi* from the continental slope off Western Europe (depth 1590–1775 m). This record is referable to *Vermiliopsis eliasoni* Zibrowius, 1970, as well as another record from the same area (1464–1555 m) (material studied, MBAP).

Bellan (1960 : 289; 1963 : 264) referred an empty tube dredged in the Mediterranean off Corsica (depth 565–610 m) to *Vermiliopsis langerhansi*; as indicated previously (Zibrowius, 1968a : 124–125) this was probably a tube of *Vermiliopsis agglutinata* (Marenzeller), a widespread species in the bathyal depths of the Mediterranean.

Chapman & Dales (1954 : 682) reported *Vermiliopsis langerhansi* from shallow water at Faial (Azores), Tenerelli (1961, 1962) from shallow water at Sicily, Bellan (1964 : 175) from shallow water algal communities in the Marseille area, Nelson-Smith (1967 : 33) from shallow water at Cap Ferrat (Mediterranean coast of France), Cabioch, l'Hardy and Rullier (1968 : 73) from the intertidal zone of Brittany. The operculum figured by Nelson-Smith (1967 : 33, fig. 20) showing a short horny operculum with calcareous deposit and longitudinal grooves, may be representative of what has generally, and erroneously, been considered as *V. langerhansi* in shallow water. All these shallow water forms are closely related to *Vermiliopsis infundibulum*: (Philippi, 1844), and had even been referred, tentatively, to that species (Zibrowius, 1968a). This group should be revised in detail.

INDETERMINABLE SERPULIDAE FROM ABYSSAL DEPTHS PREVIOUSLY REFERRED TO *PLACOSTEGUS*

Placostegus benthalianus McIntosh, 1885

Placostegus benthalianus McIntosh, 1885, p. 524, pl. 55, fig. 7, pl. 30A, fig. 28.

Material studied. North Pacific, "Challenger" Expedition: station 253, 14 July 1875, 38°09′ N, 156°25′ W, 5719 m, bottom temperature 1·72°C (type material: several fragments from abdominal region extracted from tube fragments, probably of two specimens, not one as indicated by McIntosh, BMNH. 1885.12.1.414).

Notes. The original description, based on a fragmentary specimen, is deficient in many respects. Based on the remaining fragments of the holotype, the following may be added.

Tube white, solid, subquadrangular in cross-section, not pentagonal as indicated by McIntosh; with three slightly rugose ridges in oldest part of tube, more prominent and bluntly denticulate on rather flat upper face in the younger part of the tube.

Number of thoracic and abdominal segments unknown. Details of gill tuft, collar and thoracic membranes unknown. According to McIntosh opercular stalk cylindrical, without pinnules or wings, slightly enlarged at base of operculum. Operculum vesicular, higher than wide, with horny distal plate slightly concave and yellowish brown at the rim. Thoracic setae and uncini insufficiently known. Thoracic uncini saw-shaped, with probably about 7 teeth (not 4 or 5 as mentioned by McIntosh), anterior tooth simple, not bifurcate (by analogy with abdominal uncini). Uncini of anterior abdominal segments saw-shaped, with about 7 teeth; anterior tooth simple, not bifurcate. Uncini of posterior abdominal segments rasp-shaped. Abdominal setae geniculate.

The species is too poorly known to be placed into a genus. However, it is evident that it does not belong to the genus *Placostegus*. The abdominal setae and uncini rather closely resemble those of *Bathyvermilia challengeri* (see above).

Placostegus moerchii McIntosh, 1885

Placostegus moerchii McIntosh, 1885, pp. 524–525, pl. 55, fig. 8, pl. 30A, fig. 29–30.
Protoplacostegus mörchii: Bush, 1904, pp. 179, 226; 287–288.

MATERIAL STUDIED. South Pacific, "Challenger" Expedition: station 285, 14 October 1875, 32°36′ S, 137°43′ W, 4336 m, bottom temperature 1·66°C, red clay (holotype: damaged specimen in poor condition, without tube, BMNH. 1885. 12.1.415).

NOTES. It is not possible to give an adequate description for the species. Based on the damaged holotype, the following may be added to the original description (no remnants of the opaque, white tube remain). Length about 12 mm (5 mm for gill tuft). 7 thoracic setigerous segments, 6 of them uncinigerous. Details of collar and thoracic membranes unknown; the latter probably short. Gill tuft in poor condition, about 7 filaments on each side. Second (?) dorsal filament on right side with pinnules (not differing from other filaments) with vesicular operculum. Operculum higher than wide, with bilateral symmetry. Distal face of operculum convex, slightly different from side wall, thicker, whitish but not encrusted with calcareous deposit. Second (?) dorsal filament on left side with pinnules and small globular (not differentiated) terminal knob or pseudo-operculum.

First thoracic setigerous segment with two types of setae: thicker (broken distally; limbate ? special setae ?) and thinner capillary setae; these fascicles of setae not less developed than those of the following segments. Sickle setae with short proximal limbate zone ("*Apomatus* setae") present in segments 2 to 7. Abdominal setae geniculate, with triangular blade. Thoracic uncini saw-shaped (about 10 teeth ?); anterior tooth simple, not bifurcate. Uncini of abdominal segments rasp-shaped.

The species is characterized by an opercular stalk with pinnules, not differing from the other gill filaments. This detail should be confirmed from additional specimens, since exceptional specimens of species, characterized by smooth opercular stalks, have been found bearing pinnules as in *Filogranula* (Zibrowius, 1968a: *Omphalopoma*). Vesicular opercula on opercula stalks bearing pinnules, not differing from the other filaments, are known in the genus *Protula* Risso [=*Apomatus* Philippi]. *Protula,* however, is characterized by a quite different type of uncini than those found on McIntosh's species, which are rather of the type found in *Vermiliopsis, sensu stricto,* and *Bathyvermilia.*

The genus *Protoplacostegus* was established by Bush (1904) for *Placostegus moerchii* as the type-species. The latter species, however, is too poorly known at present to give a satisfactory diagnosis.

SUMMARY

The genus *Bathyvermilia* gen. nov. is established for two abyssal serpulid species originally described under *Placostegus ornatus* by McIntosh (1885), and *Vermiliopsis langerhansi* by Fauvel (1909), the name emphasizing their morphological affinities to *Vermiliopsis, sensu stricto,* as well as their deep-sea distribution. Since the name *Placostegus ornatus* is preoccupied by a littoral species described by Mörch (1863), McIntosh's deep-sea species from the Central North and South Pacific is renamed *Bathyvermilia challengeri* sp. nov.

It is pointed out that *Bathyvermilia langerhansi,* a deep-sea species from the Central Atlantic, had been confused with littoral forms of *Vermiliopsis, sensu stricto,* from the Mediterranean, Brittany and the Azores.

Additional comments are made on two other Central Pacific abyssal serpulid species of doubtful generic status, *Placostegus benthalianus* and *Placostegus moerchii,* both incompletely described by McIntosh (1885).

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